Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A stroke-multiplying shape memory alloy (SMA) actuator comprising:

a heat sink having a first surface and a second surface; and

at least three rigid parallel elongate members, each having a long axis and being slideable relative to one another parallel to that long axis, each connected one to another by an SMA wire such that the stroke of the actuator is substantially equal to the sum of the stroke of the SMA wires, where at least the central portion of one of the SMA wires [[are]] is in close proximity to the first surface of the [[a]] heat sink, ~~and a recess formed in the heat sink separates the ends of~~ and an end portion of the one of the SMA wires is proximate to the second surface of ~~at least one SMA wire from~~ the heat sink.

2. (Original) The actuator of claim 1 where the elongate members are parallel plates.

3. (Original) The actuator of claim 2 where the elongate members are stacked parallel conductive plates electrically insulated one from another.

4. (Original) The actuator of claim 3 where each two plates are separated by a layer of polymeric material.

5. (Original) The actuator of claim 4 where the plates comprise a top plate, a bottom plate, and at least one intermediate plate, each plate having first and second ends and the first ends of all plates being aligned generally one above another and the second ends of all plates being aligned generally one above another, a first SMA wire having a first end connecting adjacent the first end of the bottom plate and a second end connecting adjacent the second end of the intermediate plate immediately thereabove, a second SMA wire having a first end connecting

adjacent the first end of an intermediate plate immediately below the top plate and a second end connecting adjacent the second end of the top plate, and there is more than one intermediate plate present, an SMA wire having a first end connecting adjacent the first end of each intermediate plate and a second end adjacent the second end of the intermediate plate immediately thereabove.

6. (Original) The actuator of claim 1 where the distance between the central portion of each SMA wire and the heat sink is not more that 10 times a diameter of the wire.

7. (Original) The actuator of claim 6 where the distance between the central portion of each SMA wire and the heat sink is not more than 8 times the diameter of the wire.

8. (Original) The actuator of claim 7 where the distance between the central portion of each SMA wire and the heat sink is between 1 and 4 times the diameter of the wire.

9. (Original) The actuator of claim 1 where at least the central 20% of each SMA wire is in close proximity to the heat sink.

10. (Original) The actuator of claim 9 where at least the central 40% of each SMA wire is in close proximity to the heat sink.

11. (Original) The actuator of claim 10 where at least the central 70% of each SMA wire is in close proximity to the heat sink.

12. (Currently amended) The actuator of claim 1 where at least the end 1 mm of each end <u>portion</u> of each SMA wire is not in close proximity to the heat sink.

13. (Currently amended) The actuator of claim 11 where at least the end 1.5 mm of each end <u>portion</u> of each SMA wire is not in close proximity to the heat sink.

14. (Original) The actuator of claim 1 where the heat sink comprises the rigid members of the actuator.

15. (Original) The actuator of claim 4 where the heat sink comprises the parallel conductive plates of the actuator.

16. (Currently amended) The actuator of claim 15 where each plate has an edge parallel to the long axis nearest an SMA wire attached to the plate adjacent an end of the plate, the edge being such that at least the central 60% of each wire is in close proximity to the edge<u>, where the</u>

plate has ~~and having~~ a recess therein adjacent a point of attachment of the wire to the plate so that the wire is not in close proximity to the edge for at least the first 1 mm of the wire from the point of attachment to the plate.

17. (Original) The actuator of claim 1 where the heat sink is external to the actuator.

18. (Original) The actuator of claim 17 where the heat sink is an active cooling element.

19. (Original) The actuator of claim 1 having a desired contraction limit and a power supply circuit supplying power to the actuator to cause it to contract, the power supply circuit comprising a switch that is normally closed when the actuator is contracted to less than the desired contraction limit and is opened by the actuator reaching the desired contraction limit.

20. Cancelled.

21. (Previously presented) A stroke multiplying actuator shape memory actuator of claim 1 wherein at least one of the rigid elongate members operates as a heat sink.

22. (Currently amended) A shape memory alloy actuator comprising:

a rigid planar elongate member having a recess formed therein; and

a shape memory alloy wire having a first end, a central portion and a second end;

wherein, the first end of the shape memory alloy wire is attached to the rigid planar elongate member proximate to and external to the recess.

23. (Previously presented) The shape memory alloy actuator of claim 22 wherein the rigid planar elongate member operates as a heat sink for the shape memory alloy wire.

24. (Previously presented) The shape memory alloy actuator of claim 22 wherein the rigid planar elongate member has a recess formed at each end.

25. (Previously presented) The shape memory alloy actuator of claim 22 further comprising

a second rigid planar elongate member having a recess formed therein and the second rigid elongate member being slideable relative to the rigid elongate member;

wherein, the second end of the shape memory alloy wire is attached to the second rigid planar elongate member proximate to the recess formed in the second rigid planar elongate member.

26. (Previously presented) The shape memory alloy actuator of claim 25 wherein the central portion of the shape memory alloy wire is in close proximity to one of the rigid planar elongate member and the second rigid planar elongate member.

27. (Previously presented) A sliding plane shape memory alloy actuator comprising:

a rigid member having a recess formed therein; and

a shape memory alloy wire attached to the rigid member;

wherein, a first heat transfer mechanism dominates the heat transfer between the central portion of the shape memory alloy wire and the rigid member; and

a second different heat transfer mechanism dominates the heat transfer between the portion of the rigid member having the recess formed therein and the portion of the shape memory alloy wire proximate to the portion of the rigid member having a recess formed therein.

28. (Previously presented) The sliding plane shape memory alloy actuator of claim 27 wherein the first heat transfer mechanism comprises the heat sink effect of the rigid member.

29. (Previously presented) The sliding plane shape memory alloy actuator of claim 27 wherein the proximity of the central portion of the shape memory alloy wire to the rigid member alters the effectiveness of the first heat transfer mechanism.

30. (Previously presented) The sliding plane shape memory alloy actuator of claim 27 wherein the second heat transfer mechanism is dominated by thermal conduction where the shape memory alloy wire is attached to the rigid member.

31. (Previously presented) The sliding plane shape memory alloy actuator of claim 28 wherein the second heat transfer mechanism is dominated by thermal conduction where the shape memory alloy wire is attached to the rigid member.

32. (Previously presented) The sliding plane shape memory alloy actuator of claim 27 wherein the shape memory alloy wire thermal gradient is modified by adjusting the relative

contributions of the first heat transfer mechanism and the second different heat transfer mechanism.

33. (Previously presented) A sliding plane shape memory alloy actuator comprising:

a rigid member having a recess formed therein; and

a shape memory alloy wire having two ends and a central portion between the two ends and one end of the shape memory alloy wire is attached to the rigid member;

wherein, the heat transfer between the rigid member and the shape memory alloy wire is related to the spacing between the rigid member and the shape memory alloy wire and the shape memory alloy wire is spaced from the rigid member at a first spacing in the central portion of the shape memory alloy wire and the shape memory alloy wire is spaced from the rigid member at a second spacing at the ends of the shape memory alloy wire.

34. (Previously presented) The sliding plane actuator of claim 33 wherein the second spacing is greater than the first spacing.

35. (Previously presented) The sliding plane actuator of claim 33 wherein the second spacing is related to the distance between the shape memory alloy wire and the recess formed in the rigid member.

36. (Previously presented) The sliding plane actuator of claim 33 wherein the second spacing is proximate to the attachment point between the shape memory alloy wire and the rigid member.

37. (New) The actuator of claim 1 wherein the second surface is a recess.

38. (New) A stroke-multiplying shape memory alloy (SMA) actuator comprising:

at least three rigid parallel elongate members,

each having a long axis and being slideable relative to one another parallel to that long axis,

each connected one to another by an SMA wire such that the stroke of the actuator is substantially equal to the sum of the stroke of the SMA wires,

each including an edge parallel to the long axis, the edge having a central edge surface and at least one end edge surface, where the central edge surface is at a first distance to at least a central wire portion of the SMA and the least one end edge surface is at a second distance to an end portion the SMA wire, wherein

the first distance is such that the central edge surface is in close proximity to the central wire portion of the SMA wire, the central edge surface operating as a heat sink to primarily effectuate heat transfer from the central wire portion, and

the second distance locates the at least one end edge surface not at close proximity to the end portion of the SMA wire so to primarily effectuate conductive heat transfer into an attachment point of one member of the at least three rigid parallel members to which the end portion of the SMA wire is connected,

wherein the second distance from a unit of surface area of the end edge surface to a nearest point on the end portion of the SMA wire is a function of at least

a dimension of the SMA wire, and

a surface area of the end edge surface,

such that the end edge surface is configured to thereby increase the operating length of the SMA wire.

39. (New) The actuator of claim 38 wherein the distance is also a function of

a thermal property of the one member and the SMA wire, and

an ambient temperature.

40. (New) The actuator of claim 38 wherein the central wire portion is at least 60% of the length of the SMA and the end edge surface resides near at least the first 1 mm along the SMA wire from the attachment point at the one member.

41. (New) The actuator of claim 38 wherein the end edge surface further comprises at least two units of surface area, where a first unit is at the second distance to a first point on the SMA wire and a second unit is at a third distance to a second point on the SMA wire, wherein the second distance is such that heat is only conductively transferred from the first point, and the

third distance is such that from the second point an amount of heat is transferred conductively into the attachment point and another amount of heat is transferred into the second unit of surface area.

42. (New) The actuator of claim 38 having a desired contraction limit and a power supply circuit supplying power to the actuator to cause it to contract, the power supply circuit comprising a switch that is normally closed when the actuator is contracted to less than the desired contraction limit and is opened by the actuator reaching the desired contraction limit.

43. (New) The actuator of claim 38 wherein the dimension is a diameter.

44. (New) A stroke-multiplying shape memory alloy (SMA) actuator comprising:

a top plate having a first end portion and a second end portion;

at least one intermediate plate having a first end portion and a second end portion;

a SMA wire having a first wire end portion connecting adjacent the first end portion of an intermediate plate immediately below the top plate and a second wire end portion connecting adjacent the end portion of the top plate;

a bottom plate having a first end portion and a second end portion, where the bottom plate, the at least one intermediate plate and the top plate are thermally conductive and are arranged in a stack, each plate having a long axis and is slideable along that long axis;

another SMA wire having a first wire end portion connecting adjacent the first end portion of the bottom plate and a second wire end portion connecting adjacent the second end portion of the intermediate plate immediately thereabove,

wherein each plate includes an edge parallel to the long axis, the edge comprising

an end edge portion associated with each of the first and the second end portions of the plate, the end edge portion having an end edge surface, a portion of which is at a distance that is not at close proximity nearest one of either the first wire end portion or the second wire end portion of one wire of either the SMA wire or the another SMA wire, the distance primarily effectuating conductive heat transfer with either the first or the second end portions of the plate, and

a central edge portion having an central edge surface that is at close proximity nearest a central wire portion of at least one of the SMA wire and the another SMA wire attached to an adjacent plate, the central edge surface configured to operate as a heat sink to primarily effectuate heat transfer with the central edge portion,

wherein the distance from a unit of surface area of the end edge surface to a nearest point on one of either the first wire end portion or the second wire end portion is a function of at least

a dimension of the one wire, and

a total surface area of the end edge surface,

such that the end edge surface is configured to thereby increase the operating length of the one wire.

45. (New) The actuator of claim 44 wherein the distance is also a function of

a thermal property of the plate and the one wire, and

an ambient temperature.

46. (New) The actuator of claim 44 wherein the central wire portion is at least 60% of the length of each wire and the end edge surface resides near at least the first 1 mm along the one wire from the point of attachment at the plate.

47. (New) The actuator of claim 44 wherein the end edge surface further comprises at least two units of surface, where a first unit is at a first distance to a first point on the one wire and a second unit is at a second distance to a second point on the one wire, wherein the first distance is such that at the first point heat is only conductively transferred and the second distance is such that at the second point heat an amount of heat is transferred conductively into either the first end portion or the second end portion of the plate and another amount of heat is transferred into at least the second unit of surface area.

48. (New) The actuator of claim 44 having a desired contraction limit and a power supply circuit supplying power to the actuator to cause it to contract, the power supply circuit comprising a switch that is normally closed when the actuator is contracted to less than the desired contraction limit and is opened by the actuator reaching the desired contraction limit.

49. (New) The actuator of claim 44 wherein the dimension is a diameter.